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How Effective Is Potential Competition?

Joseph Farrell

Number 375

May 1985

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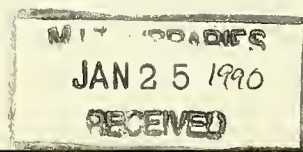


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by

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November 1984

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## 1. INTRODUCTION

Competition among firms does many useful things. It can prevent firms from raising prices above (some appropriate definition of) costs. It can be a means whereby differences in belief about what the market wants can be tested, and managers' mistakes corrected. It can be a means whereby production gets carried out by the lowest-cost producers. All these and more are supposedly benefits from actual competition among firms.

However, competition is often limited by economics of scale. The extreme case of this is the natural monopoly industry, in which minimum efficient scale exceeds market demand at minimum cost. In this case, there is an inefficiency involved in having actual competition, and there are also likely to be difficulties sustaining competition as an equilibrium.

Old-fashioned anti-trust analysts and economists worried about such industries: for instance, is it better to have some productively inefficient competition than the efficient but unrestrained monopolist? But the more recent trend has been to assert that economics of scale in themselves need not lead to any failure of the benefits of competition, as long as potential competition is available: that is, as long as entry is not blocked. In fact, "contestability theory" (Baumol, Panzar and Willig, 1982) suggests that if entry and exit are costless, then an incumbent cannot charge more than average cost.

In this paper, we present a simple analysis of the question, "How effective is potential competition in doing what actual competition is meant to do?"

We study a model of an incumbent facing potential entry, and examine his limit-pricing behavior. The claim by Schwartz and Reynolds (1983), that contestability's conclusion of average-cost pricing is not robust to small changes in assumption, is not borne out in our model; but neither is the claim by Baumol, Panzar and Willig (1983) that "where there are almost no sunk costs, markets are almost perfectly contestable."

## 2. A MODEL OF LIMIT-PRICING WITH SUNK COSTS AND RESPONSE LAGS

Consider an industry with a flow demand which we normalize at one unit per period. We suppose this demand is completely inelastic, both in order to economize on notation and in order to focus on the price-discipline effects of potential competition. A firm can satisfy this demand at a (flow) cost  $c$ , but only if it has invested an amount  $S$  in entering the industry. This cost  $S$  is sunk and not recoverable if the firm leaves.

Initially, there is an incumbent firm  $I$  serving the market. It sets a pre-entry price  $p$ , which it can change with a lag, called the response lag,  $L$ .

The second active player in the game is a (potential) entrant,  $E$ . The entrant observes  $p$ , and decides whether or not to enter.

If  $E$  does not enter, his payoff is zero. Since there is no entry,  $I$  gets a payoff valued at

$$\int_0^{\infty} e^{-rt} (p - c) dt = \frac{p-c}{r} \quad (1)$$

in present value.

However, if  $E$  chooses to enter, then (as in Baumol, Panzar and Willig, 1982),  $I$  is unable to react, by changing  $p$  or otherwise, until date  $L$ . Until then,  $E$  can price just below  $p$ , and get the whole market. Once time  $L$  arrives,  $I$  and  $E$  compete in some way we will not precisely specify; possibly, one of them will leave the industry. We simply write  $W_E$  and  $W_I$  for the present values at date  $L$  of the two firms.

We can readily calculate  $E$ 's payoff from entering:

$$\begin{aligned} \Pi_E(p; \text{enter}) &= \int_0^L (p-c)e^{-rt} dt + W_E e^{-rL} - S \\ &= (p-c) \frac{1 - e^{-rL}}{r} + W_E e^{-rL} - S \end{aligned} \quad (2)$$

This enables us to find the entry-preventing price, which we denote  $p^*$ : it is such that (2) becomes zero.

$$p^* = c + r \frac{(S e^{rL} - W_E)}{e^{rL} - 1} \quad (3)$$

$$= c + r S + \frac{r}{e^{rL} - 1} (S - W_E) \quad (4)$$

The last term in (4) measures the deviation of  $p^*$  from the average-cost price  $c + rS$ . In assessing the robustness of contestability theory to small sunk costs, we are thus concerned with the behavior of that term

$$\delta = \frac{r}{e^{rL} - 1} (S - W_E) \quad (5)$$

when  $S$  is small but positive.

Proposition 1: Given strictly positive  $r$  and  $L$ , and for any  $\varepsilon > 0$ , there exists  $S(\varepsilon) > 0$  such that if  $S < S(\varepsilon)$  then  $\delta < \varepsilon$ .

Proof: Set  $S(\varepsilon) = 1/2 \cdot \varepsilon (e^{rL} - 1)/r$ . Then (5) gives us  $\delta \leq 1/2 \varepsilon < \varepsilon$ , since  $W_E \geq 0$ , by free exit. (Equivalently, we can say that any exit costs have been included in the sunkness of  $S$ .)

Can  $\delta$  be negative? This would correspond to below-average-cost pricing by the incumbent. The analysis of (7) and (8) below tells us that this will happen only if the incumbent's costs are higher than the entrant's.

Proposition 1 seems to vindicate (in our model) the claim of Baumol, Panzar and Willig (1983) that "where there are almost no sunk costs, markets are almost perfectly contestable." But the matter is not quite so simple, as Proposition 2 will indicate:

Proposition 2: For any  $S > W_E$ , however small, and any  $\Delta$ , however large, there exists strictly positive  $r$ ,  $L$ , such that  $\delta > \Delta$ .

Proof: Take any  $r > 0$ , and choose  $L$  sufficiently small that  $e^{rL} - 1 < r(S - W_E)\Delta$ .

Proposition 2 has a bite to it only if  $W_E = 0$ . But this, of course, is precisely the case normally considered, and a very plausible one. If the entrant's best strategy is "hit-and-run" entry, then certainly  $W_E = 0$ . Likewise, we will have  $W_E = 0$  if, after date  $L$ , entrant and incumbent play a mixed-strategy equilibrium of the war-of-attrition game they find themselves in.

We now prove one further simple result on (5) when  $W_E = 0$ ; then we turn to the case of  $W_E > 0$ .

Proposition 3: When  $W_E = 0$ , and  $rL > 0$  is small, (5) is approximated by

$$\delta \approx S/L \quad (6)$$

Proof: The ratio of the claimed approximation to the correct formula is:

$$\begin{aligned} \frac{S/L}{\delta} &= \frac{S/L}{rS/(e^{rL} - 1)} \\ &= \frac{e^{rL} - 1}{rL} \\ &= 1 + (rL)/2! + (rL)^2/3! + \dots \\ &\approx 1 \text{ for small } rL. \end{aligned}$$

This tells us that, if we think of  $p^*$  as a function of  $S$  and  $L$ , then in every neighborhood of  $S = 0$ ,  $L = 0$ ,  $\delta$  takes on all nonnegative values.

Thus, simply knowing that  $S$  is small and  $L$  is positive tells us nothing at all



about the extent to which potential competition will discipline the incumbent in his price-setting. Rather, we need to know whether  $S$  is small in relation to  $L$ . We can put this a little more intuitively by expressing  $\delta$  as a fraction or multiple of  $c$ ; then we can say that the proportional price distortion allowed by the sunk cost  $S$  depends on the number of time-period's current costs that amount to  $S$ . Thus, if entry requires the sinking of two months' running costs, and the response lag  $L$  is one month,  $\delta$  is equal to twice  $c$ , representing a major distortion. If entry costs are a week's running costs, and  $L$  is one year, then  $\delta$  is only about 2% of  $c$ .

We now turn, as promised, to analysis of the case  $W_E > 0$ . For this case to obtain,  $E$  must expect either that  $I$  will leave the market at date  $L$ , so that  $E$  would become the incumbent, or else that the two firms could share the market and make a profit (not allowing for sunk costs). The latter case is inconsistent with our motivating assumption that actual competition is infeasible, so we leave it aside and concentrate on the former "displacement" case:  $E$  expects to displace  $I$  as incumbent if he enters.

Such a displacement is, of course, one equilibrium of the war-of-attrition game which will result after date  $L$  on our assumption that the market is unprofitable for two firms. We can analyze the implications of equating  $W_E$  to the incumbent's value:

$$W_E = \frac{p^* - c}{r} \quad (7)$$

$$\text{where } p^* = c + rS + \frac{r}{e^{rL} - 1} (S - W_E) \quad (8)$$

Solving (7) and (8) gives  $W_E = S$ ,  $p^* = c + rS$ . In other words, if the (self-enforcing) etiquette is for incumbents to leave if entered against, then we get average-cost limit-pricing, and no entry in equilibrium. This result is not hard to understand: since there is no entry against incumbents in equilibrium, a potential entrant contemplating entry will calculate on the assumption that he would have the market forever, and can thus amortize  $S$  on that basis.

Proposition 4: If it is the common expectation that, should E enter, I would exit at date L, then equilibrium involves average-cost pricing (and no entry) irrespective of the size of S.

While Proposition 4 is of some interest in the model as we have described it, its main importance lies in its extension to the case where firms differ in  $c$ . Suppose that initially the incumbent has costs  $c_I$ , but that the entrant, and potentially other firms, have costs  $c_E < c_I$ . Then the assumption that E would displace I is very plausible (as distinct from being just one of three equilibria of a war-of-attrition game), and it follows that, if I is to prevent entry, he must set price

$$p^* = c_E + rS_E \quad (9)$$

He will prefer to allow entry if and only if

$$c_I > c_E + rS_E \quad (10)$$

which is precisely the condition under which it is socially desirable for entry to occur:

Proposition 5: If entrant's and incumbent's costs differ, but are common knowledge, then entry occurs precisely when it saves costs overall (given that I's sunk cost is already sunk); and the price will be the entrant's long-run average cost if the incumbent chooses to prevent entry.



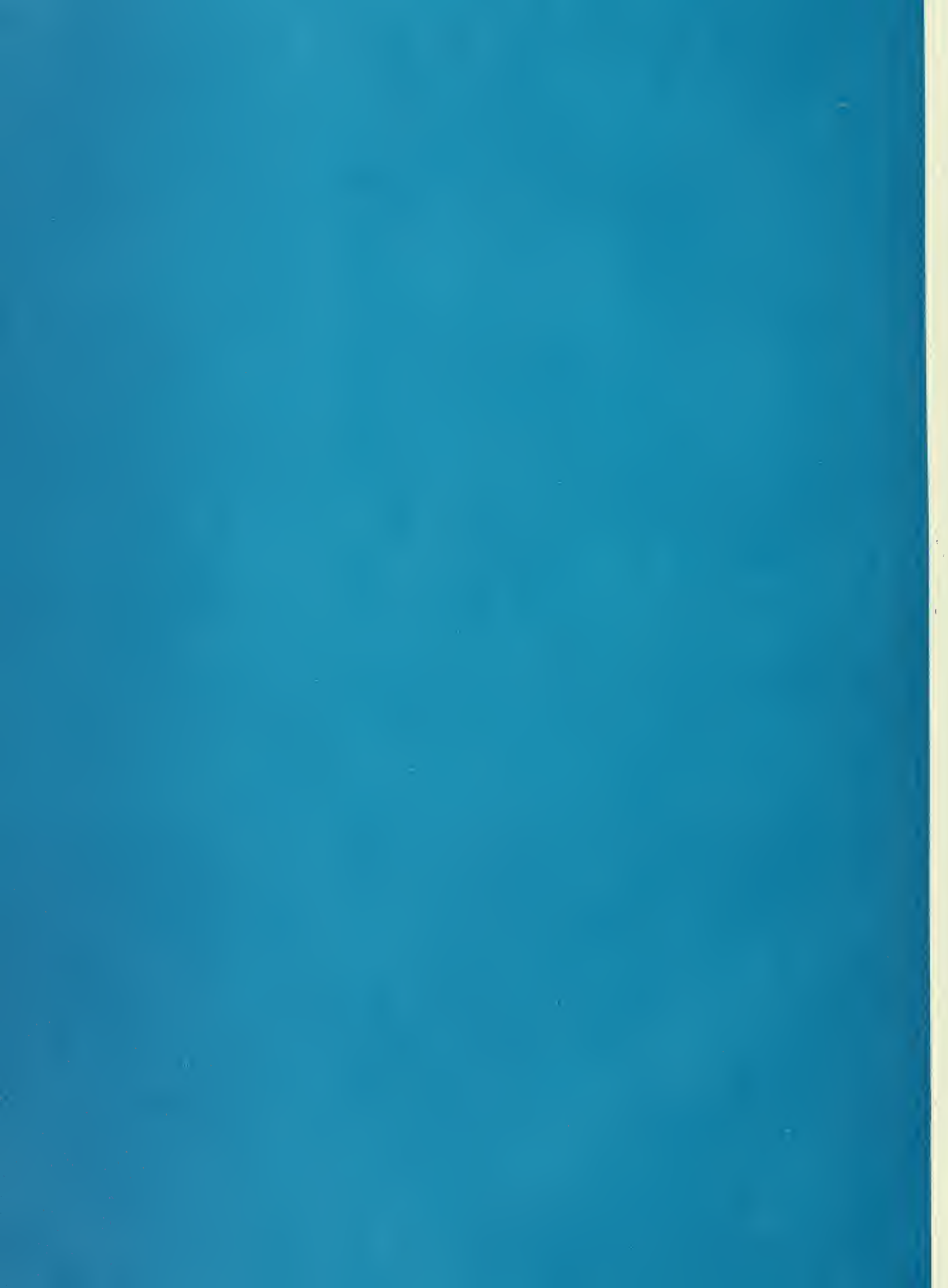
### 3. CONCLUSION

As Baumol, Panzar and Willig (1982) showed, natural monopoly in the absence of sunk costs does not lead to monopoly power to raise prices above average cost. In a model with sunk cost, we have investigated a particular dynamic story, and seen that positive sunk cost does enable incumbents to raise prices above average cost, even when we include interest on the sunk cost in "average cost." The model is continuous in  $S$  (sunk cost) when the response lag  $L > 0$  is fixed; however, if we view the equilibrium limit price as a function of  $S$  and  $L$  jointly, there is an essential discontinuity at  $S = 0, L = 0$ . This means that we cannot predict the relationship of price to average cost based solely on the smallness of  $S$  and the positivity of  $L$ : we have to have an estimate of their relative sizes.

## 4. REFERENCES

1. Baumol, William, John Panzar, and Robert Willig, Contestable Markets and the Theory of Industry Structure, San Diego: Harcourt Brace Jovanovich, 1982.
2. \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_, "Contestable Markets: An Uprising in the Theory of Industry Structure: Reply," American Economic Review 73, June 1983, 491-496.
3. Schwartz, Marius, and Robert Reynolds, "Contestable Markets: An Uprising in the Theory of Industry Structure: Comment," American Economic Review 73, June 1983, 488-490.

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